Vampir at ORNL

Trace-based Performance Analysis

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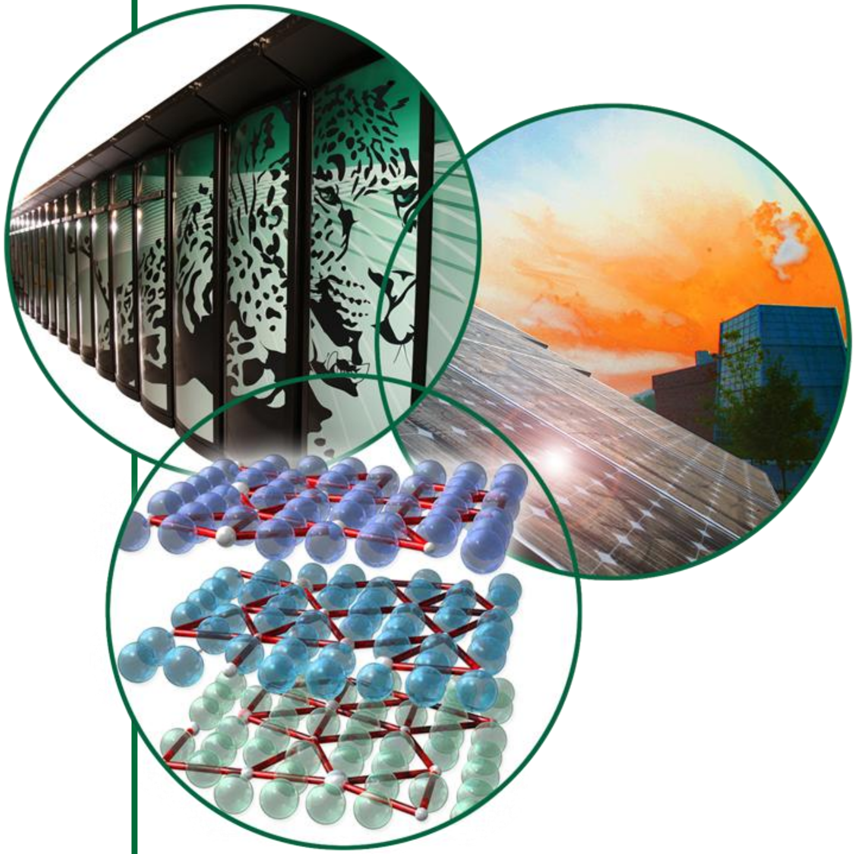

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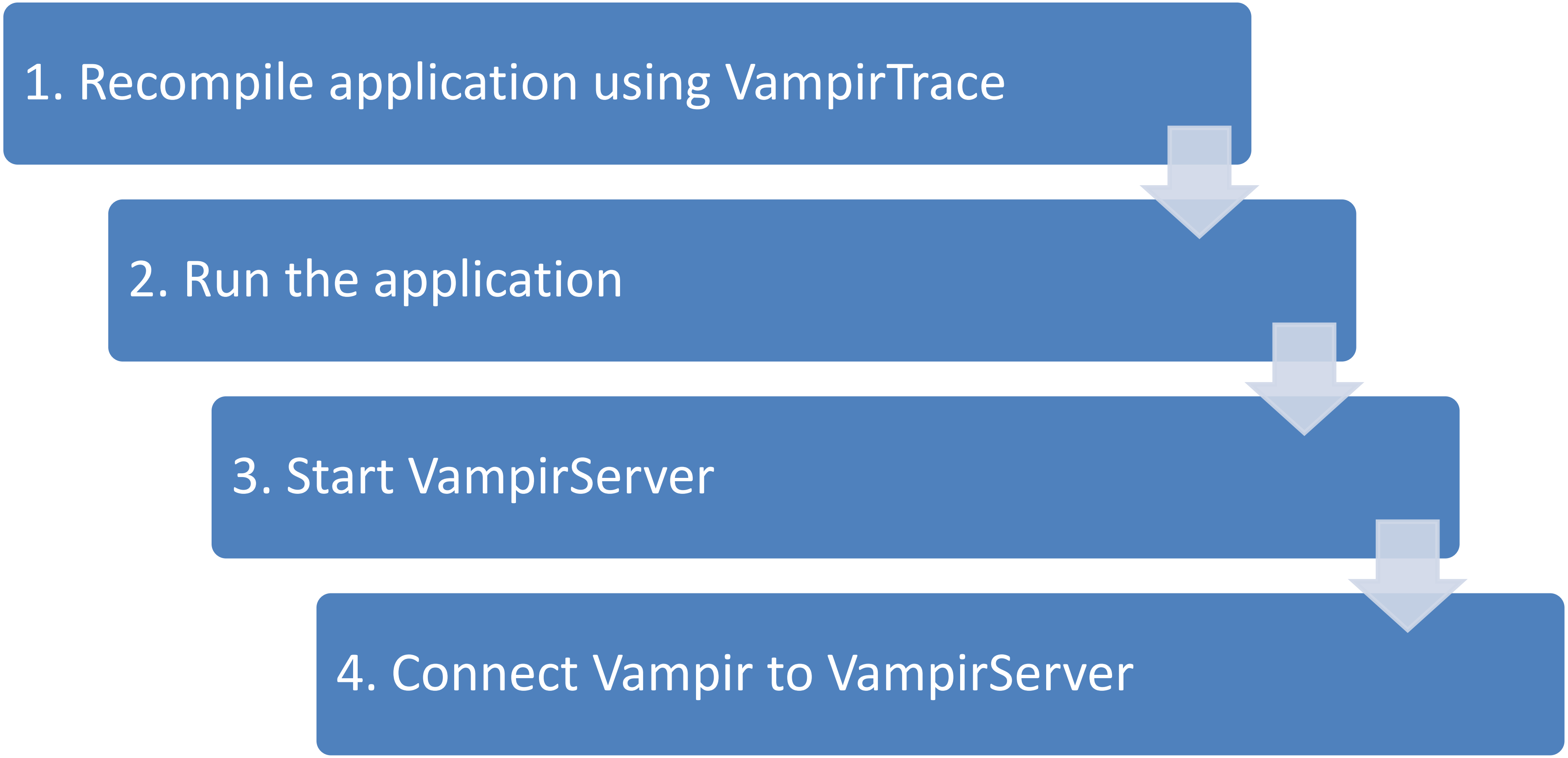
Fours steps to get you going



1. Recompile application using VampirTrace

2. Run the application

3. Start VampirServer

4. Connect Vampir to VampirServer

Step 1. Recompile application using VampirTrace

- First: `module load vampirtrace`
- Use the appropriate compiler wrappers
  - vtcc, vtCC, vtf77, vtf90
  - Pick appropriate library (seq, mpi, mt, hyb)
    - e.g. `vtcc -vt:hyb` (recommended)
  - Pick instrumentation type
    - `-vt:inst compinst` (default, compiler instrumentation, all functions)
    - `-vt:inst manual` (MPI, OpenMP, CUDA and manual)
  - See what's going on behind `-vt:show` or `-vt:verbose`
  - More details `-vt:help`
- Tell your build system to use VampirTrace
  - `./configure -with-CC=“vtcc -vt:hyb”` …

Step 2. Running the application

- Run your application as usual
- Make sure the VampirTrace module is loaded
  - Load module before and `qsub -V`
  - `module load vampirtrace` in the runscript
- Control VampirTrace by using environment variables
  - `VT_PFORM_GDIR=traces`
    - `mkdir $VT_PFORM_GDIR`
    - `lfs setstripe -c 1 $VT_PFORM_GDIR`
    - place trace files in that directory
    - Use /lustre/widow1 for large runs

Step 2. Running the application (contd.)

- Control VampirTrace by using environment variables
  - `VT_FILTER_SPEC=default.filter`
    - `cp $VAMPIRTRACE_DIR/etc/default.filter .`
    - Reduces resulting trace size by filtering frequently called functions
  - `VT_MAX_FLUSHES=20`
    - Defaults to 1
    - Allows VT to flush buffer during execution
  - `VT_BUFFER_SIZE=100M`
    - Defaults to 32M
    - Increases internal buffer size
  - `VT_SYNC_FLUSH=yes`
    - Use that if you have collective ops in your code
    - Avoids all processes waiting for one process to do trace I/O
    - But has overhead itsself (extra allreduce on all collective ops!)
  - `VT_METRICS=PAPI_FP_OPS:PAPI_TOT_INS`

Step 3+4. Analyze small traces locally (< 100 MB)

- Copy the Vampir GUI / Client to your workstation/laptop

  -
    ```
    scp home.ccs.ornl.gov:/sw/sources/vampir/client/vampir-7.*-i386.tar.gz .
    ```

  -
    ```
    tar –xzf vampir-7.*-i386.tar.gz
    ```

  -
    ```
    ./vampir/bin/vampir
    ```
- Client is available for:
  - Linux {i386, amd64}.tar.gz
  - Windows {x86, x64}.exe
  - MacOS as .dmg
- Copy trace files to your workstation/laptop

  -
    ```
    scp -r jaguarpf.ccs.ornl.gov:/tmp/…/traces/ .
    ```
- Start Vampir on your workstation/laptop
  - Open trace and enjoy!

Step 3. Start VampirServer

- VampirServer runs on the compute nodes and needs access to the generated trace files (.otf, .z)
- Currently available on jaguar, smoky, lens

-
  ```
  $ module load vampir
  $ qsub -V -I -l size=120,walltime=2:0:0 -A <ACC>
  $ vngd-start.sh
  ```
- Number of processes depends on (size of) the trace
  - Try ¼ of the cores used by the application
  - Running out of memory → add nodes
  - Getting strange MPI errors → reduce process count

Step 4. Connect Vampir to VampirServer (Linux/Mac)

- Open an SSH tunnel to the compute node

  -
    ```
    jaguarpf$ vngd-start.sh
    Launching VampirServer Version 2.3.0 with  on 12 processes ...
    Found license file: /tmp/work/tilsche/.vampir/etc/lic.dat
    Running 11 analysis processes... (abort with Ctrl-C or vngd-
    shutdown)
    Server listens on: nid13928:30051
    ```

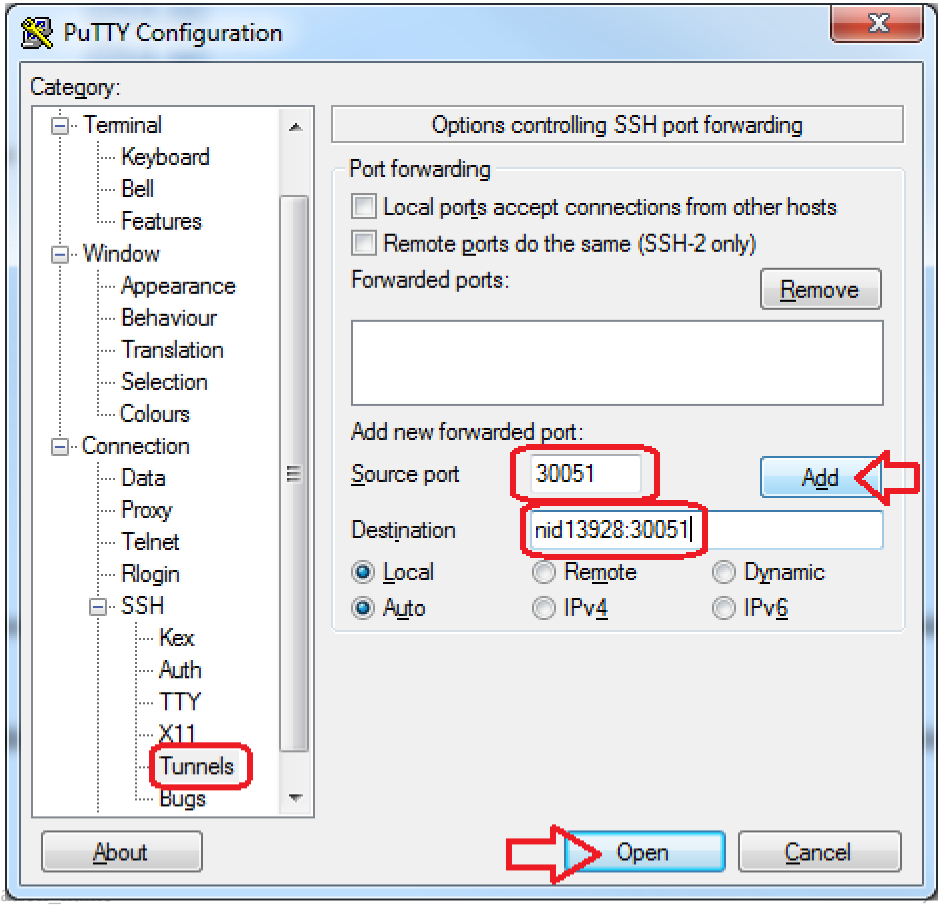
  -
    ```
    workstation$ ssh –L 30051:nid13928:30051 jaguarpf.ccs.ornl.gov
    ```
- Open Vampir and “remote open” to
  - Server: `localhost`
  - Port: `30051`

Step 4. Connect Vampir to VampirServer (Windows)

- We need an SSH tunnel to the compute node

  -
    ```
    jaguarpf$ vngd-start.sh
    Launching VampirServer Version 2.3.0 with  on 12 processes ...
    Found license file: /tmp/work/tilsche/.vampir/etc/lic.dat
    Running 11 analysis processes... (abort with Ctrl-C or vngd-shutdown)
    Server listens on: nid13928:30051
    ```

- Vampir “remote open” to
  - Server: `localhost`
  - Port: 30051



□ Local ports accept connections from other hosts

□ Remote ports do the same (SSH-2 only)

Source port: 30051

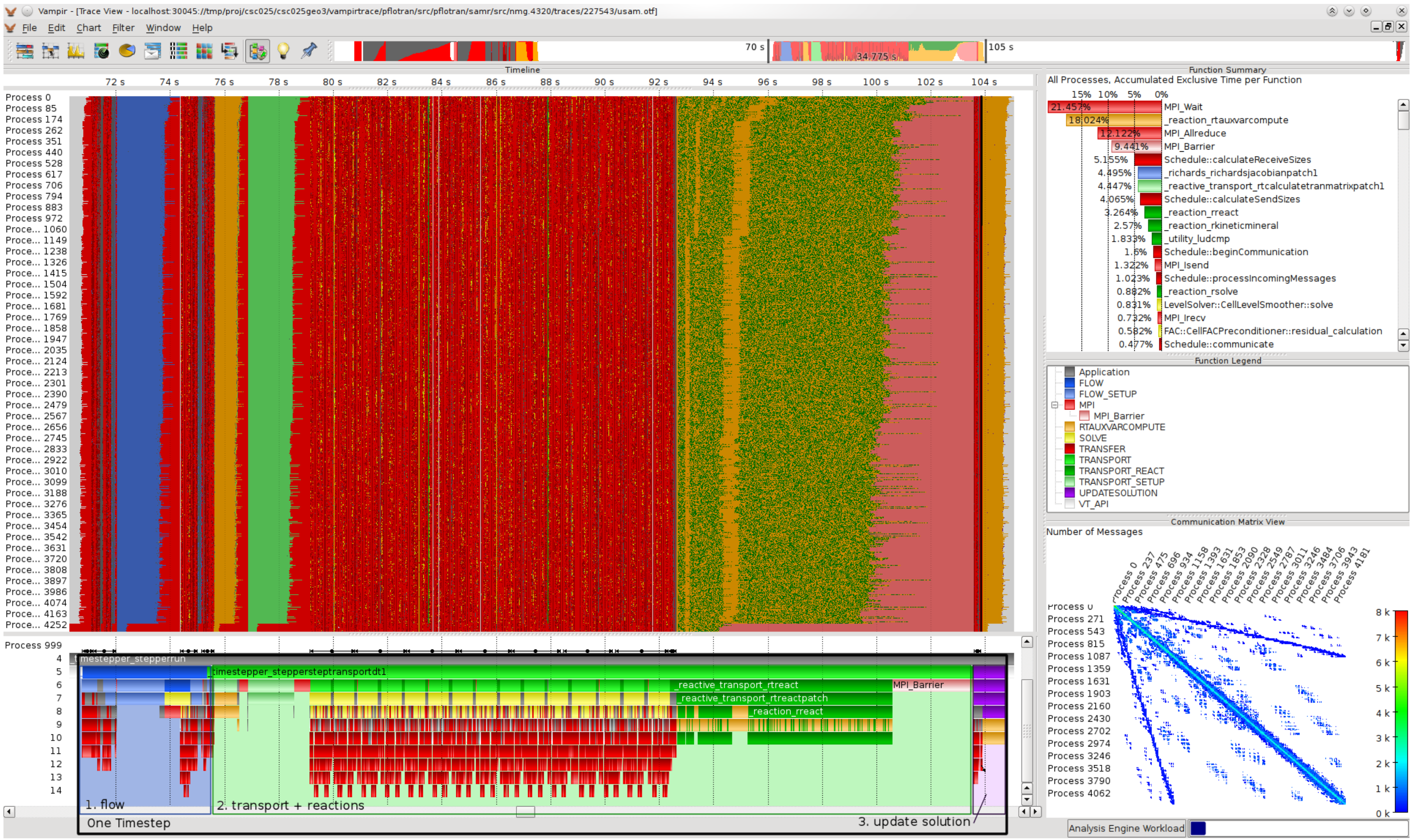
Destination: nid13928:30051

● Local ○ Remote ○ Dynamic

● Auto ○ IPv4 ○ IPv6

View your application trace:

- "Play around" with Vampir to get a feeling about the features



All Processes, Accumulated Exclusive Time per Function

21.457%	MPI_Wait
18.024%	_reaction_rtauxvarcompute
12.122%	MPI_Allreduce
9.441%	MPI_Barrier
5.155%	Schedule::calculateReceiveSizes
4.495%	_richards_richardsjacobianpatch1
4.447%	_reactive_transport_rtcalculatetranmatrixpatch1
4.065%	Schedule::calculateSendSizes
3.264%	_reaction_rreact
2.57%	_reaction_rkineticmineral
1.833%	_utility_ludcmp
1.6%	Schedule::beginCommunication
1.322%	MPI_Isend
1.023%	Schedule::processIncomingMessages
0.882%	_reaction_rsolve
0.831%	LevelSolver::CellLevelSmoother::solve
0.732%	MPI_Irecv
0.582%	FAC::CellFACPreconditioner::residual_calculation
0.477%	Schedule::communicate

Further information about VampirTrace & Vampir

- www.nccs.gov/computing-resources/jaguar/software/?software=vampir
- vampir-7.4.0-OLCF3/doc/Manual.pdf
- www.vampir.eu
- /sw/sources/vampirtrace/5.11ornl/doc/UserManual.pdf
- www.tu-dresden.de/zih/vampirtrace

Thank you

- Contact:
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Live Demo:

- Show features of Vampir using a real application trace
- Application: Pflotran (AMR Physics) running on 4320 cores
- Total trace size 242 GB
- Using ~540 analysis processes on jaguar
- Different Instrumentation means
  - Compiler instrumentation
  - Exclude function lists for compiler instrumentation
  - Manual instrumentation
  - Manual control (disable tracing except for one particular timestep)
- Uses function groups and a color scheme